CLAIMS

WHAT IS CLAIMED:

1. A method of forming a copper interconnect, the method comprising:

forming a sacrificial dielectric layer above a structure layer;

forming an opening in the sacrificial dielectric layer;

forming a copper layer above the sacrificial dielectric layer and in the opening;

forming the copper interconnect by removing portions of the copper layer above the sacrificial dielectric layer, leaving the copper interconnect in the opening;

removing the sacrificial dielectric layer above the structure and adjacent the copper interconnect; and

forming a low dielectric constant dielectric layer above the structure and adjacent the copper interconnect.

2. The method of claim 1, further comprising:

planarizing the low dielectric constant dielectric layer.

3. The method of claim 1, wherein forming the low dielectric constant dielectric layer includes forming the low dielectric constant dielectric layer out of a low dielectric constant (low K) dielectric material, having a dielectric constant K of at most about four.

4. The method of claim 1, further comprising:

forming and patterning a mask layer above the low dielectric constant dielectric layer to have a mask layer opening above at least a portion of the copper interconnect.

5. The method of claim 1, wherein forming the low dielectric constant dielectric layer includes forming the low dielectric constant dielectric layer using one of chemical vapor deposition (CVD), low-pressure CVD (LPCVD), plasma-enhanced CVD (PECVD), sputtering, physical vapor deposition (PVD), and thermal growing.

6. The method of claim 1, wherein forming the sacrificial dielectric layer includes forming the sacrificial dielectric layer out of one of an oxide, an oxynitride, silicon dioxide, a nitrogen-bearing oxide, a nitrogen-doped oxide, silicon oxynitride, a high dielectric constant (high K), where K is at least about 8, titanium oxide, tantalum oxide, barium strontium titanate, and forming the sacrificial dielectric layer using one of chemical vapor deposition (CVD), low-pressure CVD (LPCVD), plasma-enhanced CVD (PECVD), sputtering, physical vapor deposition (PVD), and thermal growing.

7. The method of claim 1, wherein forming the opening in the sacrificial dielectric layer includes forming the opening in the sacrificial dielectric layer using one of a mask of photoresist and an etch stop layer, the one of the mask of photoresist and the etch stop layer being formed and patterned above the sacrificial dielectric layer.

8. The method of claim 7, wherein using the one of the mask of photoresist and the etch stop layer includes using an etch stop layer formed of silicon nitride.

9. The method of claim 1, wherein forming the copper layer includes forming the copper layer using electrochemical deposition of copper.

10. The method of claim 9, wherein using the electrochemical deposition of the copper includes forming at least one barrier layer and a copper seed layer in the second opening before the electrochemical deposition of the copper, and planarizing the copper using chemical mechanical polishing after the electrochemical deposition of the copper.

11. A method of forming a copper interconnect, the method comprising:

forming a sacrificial dielectric layer above a structure layer;

forming an opening in the sacrificial dielectric layer;

forming at least one barrier metal layer and a copper seed layer above the sacrificial dielectric layer and in the opening;

electrochemically depositing copper above the copper seed layer above the at least one barrier metal layer;

forming the copper interconnect by removing the copper and the at least one barrier metal layer and the copper seed layer above the sacrificial dielectric layer, leaving the copper interconnect in the opening;

removing the sacrificial dielectric layer above the structure and adjacent the copper interconnect; and

forming a low dielectric constant dielectric layer above the structure and adjacent the copper interconnect.

12. The method of claim 11, further comprising:

planarizing the low dielectric constant dielectric layer.

13. The method of claim 11, wherein forming the low dielectric constant dielectric layer includes forming the low dielectric constant dielectric layer out of a low dielectric constant (low K) dielectric material, having a dielectric constant K of at most about four.

14. The method of claim 11, further comprising:

forming and patterning a mask layer above the low dielectric constant dielectric layer to have a mask layer opening above at least a portion of the copper interconnect.

15. The method of claim 11, wherein forming the low dielectric constant dielectric layer includes forming the low dielectric constant dielectric layer using one of chemical vapor deposition (CVD), low-pressure CVD (LPCVD), plasma-enhanced CVD (PECVD), sputtering, physical vapor deposition (PVD), and thermal growing.

16. The method of claim 11, wherein forming the sacrificial dielectric layer includes forming the sacrificial dielectric layer out of one of an oxide, an oxynitride, silicon dioxide, a nitrogen-bearing oxide, a nitrogen-doped oxide, silicon oxynitride, a high dielectric constant (high K), where K is at least about 8, titanium oxide, tantalum oxide, barium strontium titanate, and forming the sacrificial dielectric layer using one of chemical vapor deposition (CVD), low-pressure CVD (LPCVD), plasma-enhanced CVD (PECVD), sputtering, physical vapor deposition (PVD), and thermal growing.

17. The method of claim 11, wherein forming the opening in the sacrificial dielectric layer includes forming the opening in the sacrificial dielectric layer using one of a

mask of photoresist and an etch stop layer, the one of the mask of photoresist and the etch stop layer being formed and patterned above the sacrificial dielectric layer.

18. The method of claim 17, wherein using the one of the mask of photoresist and the etch stop layer includes using an etch stop layer formed of silicon nitride.

19. The method of claim 11, wherein removing the copper and the at least one barrier metal layer and the copper seed layer includes planarizing the copper.

20. The method of claim 19, wherein planarizing the copper includes using chemical mechanical polishing.

21. A method of forming a copper interconnect, the method comprising:

forming a first sacrificial dielectric layer above a structure layer;

forming a second sacrificial dielectric layer above the first sacrificial dielectric layer;

forming a first opening in the first sacrificial dielectric layer and a second opening in the second sacrificial dielectric layer;

forming a copper layer above the first and second sacrificial dielectric layers and in the first and second openings;

forming the copper interconnect by removing portions of the copper layer above the second sacrificial dielectric layer, leaving the copper interconnect in the first and second openings;

removing the first and second sacrificial dielectric layers above the structure and adjacent the copper interconnect; and

forming a low dielectric constant dielectric layer above the structure and adjacent the copper interconnect.

22. The method of claim 21, further comprising:

planarizing the low dielectric constant dielectric layer.

23. The method of claim 21, wherein forming the low dielectric constant dielectric layer includes forming the low dielectric constant dielectric layer out of a low dielectric constant (low K) dielectric material, having a dielectric constant K of at most about four.

24. The method of claim 21, further comprising:

forming and patterning a mask layer above the low dielectric constant dielectric layer to have a mask layer opening above at least a portion of the copper interconnect.

25. The method of claim 21, wherein forming the low dielectric constant dielectric layer includes forming the low dielectric constant dielectric layer using one of chemical vapor deposition (CVD), low-pressure CVD (LPCVD), plasma-enhanced CVD (PECVD), sputtering, physical vapor deposition (PVD), and thermal growing.

26. The method of claim 21, wherein forming the first and second sacrificial dielectric layers includes forming the first and second sacrificial dielectric layers out of at least one of an oxide, an oxynitride, silicon dioxide, a nitrogen-bearing oxide, a nitrogen-doped oxide, silicon oxynitride, a high dielectric constant (high K), where K is at least about 8, titanium oxide, tantalum oxide, barium strontium titanate, and forming the first

and second sacrificial dielectric layers using at least one of chemical vapor deposition (CVD), low-pressure CVD (LPCVD), plasma-enhanced CVD (PECVD), sputtering, physical vapor deposition (PVD), and thermal growing.

27. The method of claim 21, wherein forming the first and second openings in the first and second sacrificial dielectric layers includes forming the first and second openings in the first and second sacrificial dielectric layers using an etch stop layer and a mask of photoresist, respectively, the etch stop layer and the mask of photoresist being formed and patterned above the first and second sacrificial dielectric layers, respectively.

28. The method of claim 27, wherein using the at least one of the mask of photoresist and the etch stop layer includes using at least one etch stop layer formed of silicon nitride.

29. The method of claim 21, wherein forming the copper layer includes forming the copper layer using electrochemical deposition of copper.

30. The method of claim 29, wherein using the electrochemical deposition of the copper includes forming at least one barrier layer and a copper seed layer in the second opening before the electrochemical deposition of the copper, and removing the portions of the copper layer includes planarizing the copper using chemical mechanical polishing after the electrochemical deposition of the copper.

31. A method of forming a copper interconnect, the method comprising:

forming a first sacrificial dielectric layer above a structure layer;

forming a second sacrificial dielectric layer above the first sacrificial dielectric layer;

forming a first opening in the first sacrificial dielectric layer and a second opening in the second sacrificial dielectric layer;

forming at least one barrier metal layer and a copper seed layer above the first and second sacrificial dielectric layers and in the first and second openings;

electrochemically depositing copper above the copper seed layer above the at least one barrier metal layer;

forming the copper interconnect by removing the copper and the at least one barrier metal layer and the copper seed layer above the second sacrificial dielectric layer, leaving the copper interconnect in the first and second openings;

removing the first and second sacrificial dielectric layers above the structure and adjacent the copper interconnect; and

forming a low dielectric constant dielectric layer above the structure and adjacent the copper interconnect.

32. The method of claim 31, further comprising:

planarizing the low dielectric constant dielectric layer.

33. The method of claim 31, wherein forming the low dielectric constant dielectric layer includes forming the low dielectric constant dielectric layer out of a low dielectric constant (low K) dielectric material, having a dielectric constant K of at most about four.

34. The method of claim 31, further comprising:

forming and patterning a mask layer above the low dielectric constant dielectric layer to have a mask layer opening above at least a portion of the copper interconnect.

35. The method of claim 31, wherein forming the low dielectric constant dielectric layer includes forming the low dielectric constant dielectric layer using one of chemical vapor deposition (CVD), low-pressure CVD (LPCVD), plasma-enhanced CVD (PECVD), sputtering, physical vapor deposition (PVD), and thermal growing.

36. The method of claim 31, wherein forming the first and second sacrificial dielectric layers includes forming the first and second sacrificial dielectric layers out of at least one of an oxide, an oxynitride, silicon dioxide, a nitrogen-bearing oxide, a nitrogen-doped oxide, silicon oxynitride, a high dielectric constant (high K), where K is at least about 8, titanium oxide, tantalum oxide, barium strontium titanate, and forming the first and second sacrificial dielectric layers using at least one of chemical vapor deposition (CVD), low-pressure CVD (LPCVD), plasma-enhanced CVD (PECVD), sputtering, physical vapor deposition (PVD), and thermal growing.

37. The method of claim 31, wherein forming the first and second openings in the first and second sacrificial dielectric layers includes forming the first and second openings in the first and second sacrificial dielectric layers using an etch stop layer and a mask of photoresist, respectively, the etch stop layer and the mask of photoresist being formed and patterned above the first and second sacrificial dielectric layers, respectively.

38. The method of claim 37, wherein using the at least one of the mask of photoresist and the etch stop layer includes using at least one etch stop layer formed of silicon nitride.

39. The method of claim 31, wherein removing the copper and the at least one barrier metal layer and the copper seed layer includes planarizing the copper.

40. The method of claim 39, wherein planarizing the copper includes using chemical mechanical polishing.